

CARBON AND OXYGEN ISOTOPE COMPOSITION OF CARBONATES FROM AN L6 CHONDRITE: EVIDENCE FOR TERRESTRIAL WEATHERING FROM THE HOLBROOK METEORITE; R. A. Socki¹, E. K. Gibson², A. J. T. Jull³, and H. R. Karlsson². ¹LESC and ²SN2, NASA-JSC, Houston, TX 77058, ³NSF Facility for Radioisotope Analysis, Univ. of Arizona, Tucson, AZ 85721, all USA.

Introduction. Terrestrial weathering in meteorites is an important process which alters pristine elemental and isotopic abundances. The Holbrook L6 chondrite fell in 1912. Material was recovered at the time of the fall, in 1931 and 1968. The weathering processes operating on the freshly fallen meteorite in a semi-arid region of northeastern Arizona have been studied after a ground residence of 19 and 56 years by (1). Karlsson, et al. (2) showed that a large portion of the carbonate material in 7 Antarctic ordinary chondrites either underwent extensive isotopic exchange with atmospheric CO₂, or formed recently in the Antarctic environment. In fact (3) demonstrated that hydrated Mg-carbonates, nesquehonite and hydromagnesite, formed in less than 40 yrs. on LEW 85320.

In order to help further constrain the effects of terrestrial weathering in meteorites, we have examined the carbon and oxygen isotopes extracted from carbonates of three different samples of Holbrook: a fresh sample at the time of the fall in 1912, a specimen collected in 1931, and a third specimen collected at the same site in 1968 (4). The effects of weathering on the chemical and noble gas isotopic compositions in the three Holbrook samples was shown by (1). Total carbon concentration increases up to a factor of three from the fresh fall to samples collected 19 years later. Carbonates in Holbrook are particularly well-suited for examining terrestrial weathering effects since their stable isotopes exchange readily at low temperatures. Furthermore, C-14 data will allow us to confirm both a pre- and post-bomb component.

Experimental Methods. Four powdered bulk meteorite samples from Holbrook (duplicate 1912 samples, a 1931 sample, and a 1968 sample) were reacted with 100% phosphoric acid releasing CO₂ for isotopic analysis. The reactions were carried out at 50°C for five days. The oxygen isotope fractionation factor of 1.00903 from (5) was assumed for this reaction. An additional step to remove H₂S involved passing the LN₂ condensable gasses over Ag₃PO₄, precipitating Ag₂S. After stable isotope analyses, the CO₂ was retrieved, reduced to graphite over hot iron and the ¹⁴C abundances analyzed by accelerator mass spectrometry.

Results and Discussion. The ¹³C and ¹⁸O data for carbonates extracted from the 4 Holbrook samples are plotted as a function of recovery age in Figs. 1 and 2. Carbon isotope composition ranges from -6.7‰ to -2.2‰ PDB, becoming steadily enriched in ¹³C with increasing residence time on the ground. Carbon isotopic composition approaches the theoretical composition of calcite in equilibrium with atmospheric CO₂ (6) (dashed line). Oxygen isotope composition of the 1931 and 1968 samples are essentially identical at ~+33‰, and elevated relative to the 1912 duplicate (mean +27.3‰). A low CO₂ yield from the 1912 samples, indicating the absence of appreciable carbonate, is consistent with bulk carbon data from (1). The data indicate that a significant amount of carbonate probably formed in the Holbrook meteorite between the 1912 and 1931 interval. These results show that the carbon and oxygen isotopic abundances can be significantly altered in remarkably short periods of time on earth, similar to what is inferred for the Antarctic meteorites(2,3). ¹⁴C analyses are underway and will be presented.

References. (1) Gibson, E.K. Jr. and Bogard, D.D. (1978) *Meteoritics* 13, 277. (2) Karlsson, H.R., et al. (1991) *LPSC XXII*, 689. (3) Jull, A.J.T., et al. (1988) *Science* 242, 417. (4) Gibson, E.K. Jr. (1970) *Meteoritics* 5, 57. (5) Clayton, R.N. and Mayeda, T.K. (1988) *GCA* 52, 925. (6) Bottinga, Y. (1968) *J. Phys. Chem.* 72, 800.

